

What is claimed is:

1. A lithium battery separator having a shutdown function and comprising a porous carrier having a porous inorganic nonelectroconductive coating on and in this carrier,
5 characterized in that
the inorganic coating, which comprises oxidic particles of the elements Al, Si and/or Zr having an average particle size in the range from 0.5 to 10 μm , supports a porous shutdown layer composed of a material which melts at a predetermined temperature and closes the pores of the inorganic layer, the shutdown layer being formed by a porous
10 sheetlike structure and the carrier comprising woven or non-woven polymeric or glass fibers.
2. A separator as per claim 1,
characterized in that
15 the shutdown layer is formed by a woven, nonwoven, felt, formed-loop knit or porous film.
3. A separator as per claim 1 or 2,
characterized in that
the carrier is flexible and less than 50 μm in thickness.
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4. A separator according to claim 3,
characterized in that
the carrier is a polymeric nonwoven.
- 25 5. A separator according to at least one of claims 1 to 4,
characterized in that
the polymeric fibers of the carrier are selected from fibers of polyacrylonitrile, polyester and/or polyamide.
- 30 6. A separator according to at least one of claims 1 to 5,
characterized in that
the shutdown layer is from 1 to 20 and preferably from 5 to 10 μm in thickness.

7. A separator as per at least one of claims 1 to 6,
characterized in that
the shutdown layer consists of a material selected from polymers, polymer blends, natural
5 or artificial waxes or mixtures thereof.
8. A separator as per at least one of claims 1 to 7,
characterized in that
the shutdown layer consists of a material which has a melting temperature of less than
10 130°C.
9. A separator as per at least one of claims 1 to 8,
characterized in that
the material of the shutdown layer and at least portions of the material of the carrier are
15 identical.
10. A process for producing a separator having a shutdown function,
which comprises
a porous inorganic layer of a separator having applied to and fixed on it a porous sheetlike
20 structure as a porous layer (shutdown layer) composed of a material which has a defined,
desired melting temperature which is not more than the melting temperature of the carrier
material and less than the melting temperature of the inorganic layer.
11. A process according to claim 10 for producing a separator as per at least one of claims 1 to
25 9.
12. A process according to claim 10 or 11,
wherein
the porous inorganic layer is hydrophobicized before the shutdown layer is applied to it.
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13. A process as per any one of claims 10 to 12,
wherein

the porous inorganic layer is treated with an adhesion promoter before the shutdown layer is applied to it.

14. A process according to claim 13,

5 wherein

the porous inorganic layer is produced by using a polymeric sol comprising a silane adhesion promoter for the shutdown layer to be applied later.

15. A process as per either of claims 13 and 14,

10 wherein

the adhesion promoter is selected from hydrolyzed or nonhydrolyzed functionalized alkyltrialkoxysilanes.

16. A process according to at least one of claims 10 to 15,

15 wherein

the shutdown layer is created by applying a woven, formed-loop knit, felt, nonwoven or porous film to the porous inorganic layer.

17. A process according to at least one of claims 10 to 16,

20 wherein

the shutdown layer applied to the porous inorganic layer is heated once to a temperature above 50 and below the melting temperature of the material of the shutdown layer so that the shutdown layer are adhered to the separator via the adhesion promoters.

25 18. A process according to at least one of claims 10 to 16,

wherein

the shutdown layer applied to the porous inorganic layer is fixed by single heating to a temperature above the glass transition temperature to incipiently melt the material without changing the actual shape.

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19. A process according to at least one of claims 10 to 17,

wherein

the shutdown layer is applied to the porous inorganic layer by laminating.

20. A process according to at least one of claims 10 to 16,

wherein

5 the shutdown layer is applied to the porous inorganic layer and fixed by being trapped in a coil wound during battery fabrication.

21. A process according to at least one of claims 10 to 20,

wherein

10 the material for the shutdown layer is selected from polymers, polymer blends, natural and/or artificial waxes to have a melting temperature of less than 180°C.

22. A process according to claim 21,

wherein

15 the shutdown material used is polyethylene (wax).

23. The use of a separator as per at least one of claims 1 to 9 as a separator in lithium batteries.

24. A battery comprising a separator as per at least one of claims 1 to 9.